Moore's Creek Fecal Coliform TMDL Implementation Plan

Thomas Jefferson Planning District Commission

Prepared by the Thomas Jefferson Planning District Commission for the Virginia Department of Environmental Quality and the Virginia Department of Conservation and Recreation

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1.0 Executive Summary

This Total Maximum Daily Load (TMDL) implementation plan (IP) for Moore's Creek has been developed to establish an action plan to bring Moore's Creek into compliance with water quality standards. Achieving this goal will result in removing Moore's Creek from the 303(d) list of impaired waters. The plan was developed by the Thomas Jefferson Planning District Commission (TJPDC), working with a Technical Committee, and is based on plans and studies completed by agencies represented on the Committee.

Since Moore's Creek has been identified as an impaired waterway, Virginia was required to develop a TMDL for each pollutant. A TMDL is a "pollution budget" for a stream, setting limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. The TMDL for Moore's Creek was prepared by the Department of Civil Engineering at the University of Virginia (UVA) and the Thomas Jefferson Planning District Commission (TJPDC). Virginia's Department of Environmental Quality (DEQ) and Department of Conservation and Recreation (DCR) submitted the TMDL to the Environmental Protection Agency (EPA). EPA approved the Moore's Creek TMDL in May 2002. The allocation scenario that met the TMDL target called for the removal of all non-permitted human sources (straight pipes, sewer system leakage, and failing septic systems) and all cattle from the stream, as well as reductions in grassland, residential, and urban loads.

This implementation plan (IP) outlines objectives and actions to achieve the following implementation goals:

- Remove cattle from the stream and achieve targeted reductions in grassland inputs.
- Implement stormwater best management practices to aid in reducing inputs from urban uses.
- Reduce inputs in residential and urban areas through removal of leaking sewers and failing septic systems.
- Reduce inputs in rural areas through removal of failing septic systems and straight pipes.
- Reduce inputs in urban, residential and rural areas through education.
- Through planning activities, identify and prioritize opportunities for stream protection and restoration, and ensure that codes and design standards are "water-quality" friendly.
- Perform inspection, monitoring and maintenance activities to eliminate illicit discharges, ensure proper stormwater system performance and prevent pollution.

Actions to realize these goals are to be implemented in a staged process. Implementation actions in the IP include:

- Agricultural best management practices (BMPs), including fencing, stream buffers, alternative watering systems, stream crossings, and a manure storage facility
- Stream bank protection and stabilization projects, consisting of erosion control measures

- Stormwater BMPs, including daylighting of streams, vegetated buffers, infiltration galleries, and creation of wetlands, ponds and floodplains
- Sanitary sewer system improvements, including smoke/dye testing of sewer lines, sewer line maintenance and inspection, upgrading of selected collector and sewer lines, manhole relining, and providing sewer service to areas with failing drainfields
- Correction of failing septic systems and straight pipes; including pumping and repair of failing septic systems at Southwood Mobile Home Park, developing a funding assistance program for septic problems, and developing a plan for straight pipe detections.
- Education programs, including public education on pet waste management, creating a website with the capacity to track citizen complaints, dovetailing water quality education with Standards of Learning in schools, creating and distributing brochures and fact sheets to homeowners and others, and expansion of the Adopt-a-Stream Program.
- Planning activities: completion of Albemarle's stormwater master plan, amendments to City Code, adoption of design standards, revision and improvement of UVA's stormwater master plan, and use of new development/redevelopment as opportunities for stream restoration
- Maintenance activities: enact an illicit discharge ordinance, develop mechanisms to detect and address illicit discharges, upgrade the storm drain Geographic Information System (GIS), enhance scope of the StreamWatch Program, perform stormwater maintenance and repairs, and develop mechanisms to prevent pollution

A number of these activities will be carried out as part of the regular budgets of Albemarle County, the City of Charlottesville and UVA. Others, such as sewer line extensions, may be accomplished through the regular budgets, but could be completed much more quickly with outside funding. Some activities, such as developing an assistance program for owners of failing septic systems, are unlikely to occur without outside funding. Sources of outside funding include grant programs such as the Chesapeake Bay Small Watershed Grants Program and EPA's Section 319 program, cost-share programs such as the Conservation Reserve Enhancement Program and Virginia Agricultural Best Management Practices Cost-Share Program, mitigation funds such as the Virginia Aquatic Resources Trust Fund, and loan programs such as the Virginia Water Facilities Revolving Loan fund.

Cost-benefit analysis indicates that the most "bang for the buck" can be obtained from agricultural BMPs, repair/replacement of septic systems and septic system owner education, and pet waste education. If funding is obtained and implementation occurs according to schedule, it is projected that approximately 68% of the water quality standard compliance goal should be achieved by 2010. A major revisitation of the plan should occur at that five-year point in order to ensure full compliance within ten years of the acceptance of the implementation plan.

2.0 Introduction

This document serves as the Total Maximum Daily Load (TMDL) implementation plan (IP) for Moore's Creek in Albemarle County and the City of Charlottesville, Virginia. The Moore's Creek watershed covers 34.92 square miles of Albemarle County and the City of Charlottesville, Virginia. The creek forms much of the southern boundary of Charlottesville, draining the southern part of the city and parts of Albemarle County to the south and west of the city. The watershed is predominantly forested, with residential areas, grasslands, and urban areas the other major land uses. The total length of the creek is approximately 11 miles; the segment listed as not meeting Virginia's fecal coliform standard for contact recreational use is a 6.37-mile reach from the intersection of US Route 29 and County Route 1106 to the confluence of Moore's Creek with the Rivanna River, of which it is a tributary.

Fig. 2.1 The Moore's Creek watershed, with major roads and the Charlottesville boundary shown

The creek was first listed on Virginia's 303(d) list of impaired waters list in 1998, as required by federal law. The Clean Water Act (CWA) that became law in 1972 requires that all U.S. streams, rivers, and lakes meet certain water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many stream segments do not meet state water quality standards for protection of beneficial uses. According to Virginia Water Quality Standards (9 VAC 25-260-10), "all state waters are designated for the following uses: recreational uses (e.g., swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish)".

When streams fail to meet standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130) requires states to develop TMDLs for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in the stream. These measures are implemented in a staged process that is described along with specific BMPs in the implementation plan. The scope of this IP includes agricultural BMPs, stream buffer and restoration projects, measures to address leaking sewer systems, failing septic systems and straight pipes, and education programs. Details include measurable goals and milestones, stakeholders' roles and responsibilities, and potential funding sources.

The listing for Moore's Creek was done under the fecal coliform bacteria standard that had been in effect from 1987-2003. This standard (9 VAC 25-260-170) stated:

"…the fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a 30-day period, or a fecal coliform bacteria level of 1,000 per 100 ml at any time."

In January 2003, a new E. coli standard and an interim fecal coliform standard were instituted. The changes bring Virginia in line with EPA criteria issued in 1986. The interim standard states:

"Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 ml of water. This criterion shall not apply for a sampling station after the bacterial indicators described in subdivision 2 of this subsection have a minimum of 12 data points or after June 30, 2008, whichever comes first."

The applicable indicator for Moore's Creek and all freshwater bodies will ultimately be E. coli, with a geometric mean of 126 and a maximum of 235 bacteria per 100 ml of water. Prior to and during the TMDL study, only fecal coliform (and not E. coli) was measured. During implementation, monitoring of fecal coliform will continue to allow comparisons with previously collected data. E. coli will also be monitored during implementation to evaluate success against the interim E. coli water quality standard.

3.0 State and Federal Requirements for Implementation Plans

There are a number of state and federal requirements and recommendations for TMDL IPs. This chapter has three sections that discuss the a) requirements outlined by the Water Quality Monitoring, Information, and Restoration Act (WQMIRA) that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, b) EPA recommended elements of IPs, and c) required components of an IP in accordance with Section 319 guidance.

3.1 State Requirements

The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs the Virginia Department of Environmental Quality (DEQ) to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for IPs to be approved by the Commonwealth, they must meet the requirements as outlined by WQMIRA.

WQMIRA requires that IPs include the following:

- Date of expected achievement of water quality objectives;
- Measurable goals;
- Necessary corrective actions;
- Associated costs, benefits, and environmental impact of addressing the impairment.

3.2 Federal Recommendations

Section 303(d) of the CWA and current EPA regulations do not require the development of implementation strategies. EPA did, however, outline the minimum elements of an approvable IP in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process." The listed elements include:

- A description of the implementation actions and management measures;
- A time line for implementing these measures;
- Legal or regulatory controls;
- The time required to attain water quality standards, and
- A monitoring plan and milestones for attaining water quality standards.

The Guidance Manual for Total Maximum Daily Load Implementation Plans, published by the Virginia Department of Conservation and Recreation (DCR) and Virginia DEQ, strongly suggests that the EPA recommendations be addressed in the IP (in addition to the required components as described by WQMIRA).

3.3 Requirements for Section 319 Fund Eligibility

EPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to states. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003"

identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;
3. Describe the non-point source (NPS) management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan;
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and progress is being made towards attaining water quality standards, and if not, the criteria for determining if the watershed-based plan needs to be revised;
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

4.0 Review of TMDL Development

Water quality sampling on Moore's Creek between August 1991 and January 2002 found that 14.5% of the water samples violated the instantaneous fecal coliform standard of 1,000 cfu/100 ml and that the 30-day geometric mean standard of 200 cfu/100 ml was violated 59% of the time. Samples were taken upstream of the Rivanna Water and Sewer Authority (RWSA) wastewater treatment plant bridge by both DEQ and RWSA. Table 4.1 summarizes the sampling done on Moore's Creek prior to TMDL development.

Table 4.1. Fecal coliform bacteria sampling in Moore's Creek 8/91 – 1/02

Entity	Sampling dates	Number of samples	Maximum value	% violations of instantaneous criterion	% violations of 30-day mean geometric criterion
DEQ	8/91 – 1/02	45	2,600 cfu/ 100 ml	20%	--*
RWSA	10/97 – 1/02	218	200,000 cfu/ 100 ml	13%	59%

*DEQ's sampling frequency was insufficient for calculation of the 30-day geometric mean.

Due to the high percentage of violations (over 10%) the stream was placed on Virginia's 1998 303(d) list of impaired waters. A 6.37-mile reach from the intersection of U.S. Route 29 and County Route 1106 to the confluence of the Rivanna River was listed as impaired due to elevated levels of fecal coliform bacteria.

In response to the impairment, a TMDL for fecal coliform bacteria was developed for Moore's Creek. The TMDL took into account all sources of fecal coliform bacteria, including background sources, considered critical conditions and seasonal variability, and included a margin of safety. Community participation was encouraged throughout the process. The TMDL was prepared by the Department of Civil Engineering at the University of Virginia and the Thomas Jefferson Planning District Commission, and submitted to EPA by DEQ and DCR. EPA approved the TMDL for Moore's Creek in May 2002.

4.1 Bacteria Sources and Loading

Fecal coliform bacteria originate from all warm-blooded animals and can contaminate a stream from both point and nonpoint sources. In the Moore's Creek watershed, fecal coliform bacteria are discharged from two point sources, the Moore's Creek Advanced Wastewater Treatment Plant, operated by the RWSA, and Southwood Mobile Home Park, which operates its own package treatment plant. The average fecal coliform concentration in the Moore's Creek Plant effluent is 17 cfu/100 ml, and the average volume of outflow is 11 million gallons per day. This facility discharges just downstream from the state water quality monitoring site. The Southwood Mobile Home Park is located along Biscuit Run upstream of the water quality monitoring site. At the time of the TMDL, the facility was considered as maintaining its permitted discharge. The plant has a permit limit of 200 cfu/100 ml and an average outflow of 39,000 gallons

per day. The Facility is operating under a consent decree requiring the plant to hook up to the Albemarle County Service Authority (ACSA) system, thereby eliminating this point source.

Land use is varied in the Moore's Creek watershed. A digital map (Figure 4.1) was developed by TJPDC for the TMDL, based primarily on aerial photographs taken in March 2000. Land cover includes 56.2% forest, 9.8% low-density residential, 8.6% medium-density residential, 14.7% grasslands, 9.9% urban, and 0.8% water. Nonpoint sources include background wildlife, livestock, pets, and humans. Major wildlife species are deer, geese, raccoons, muskrat, and beaver. Wildlife loads were applied to both the

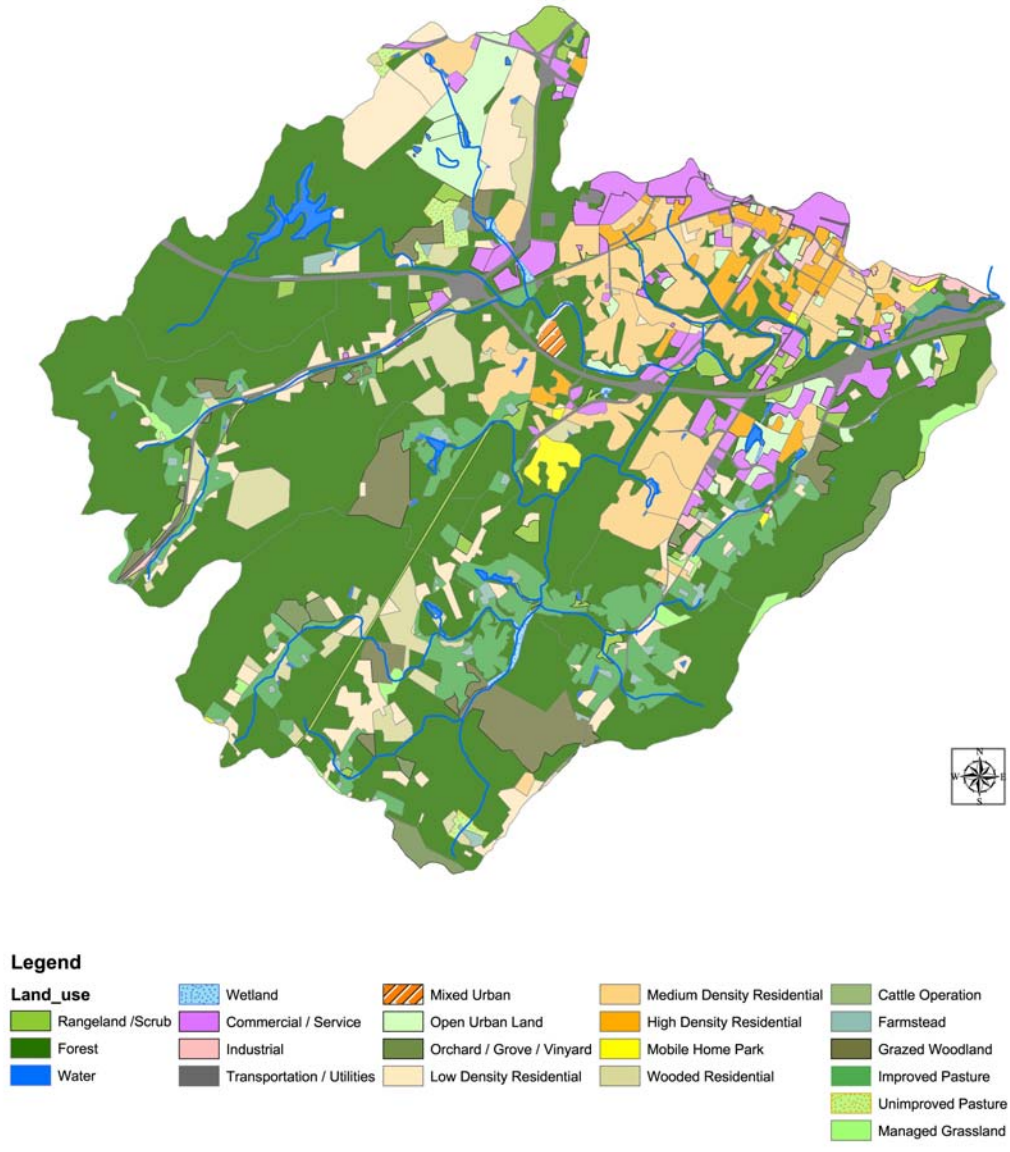

Fig. 4.1 TMDL land use map

land surface and as direct input to the stream. Although agriculture is not intensive in the Moore's Creek watershed, cattle, horses, and goats contributed to the fecal coliform load to the land. In addition, cattle had access to the stream at two sites, where direct cattle loads to the stream can occur. Pet loads are dominated by dogs. Human nonpoint source loads come from failing septic systems, straight pipes to the stream, and leakage from sanitary sewers. A bacterial source tracking study conducted by James Madison University (Wiggins, 2001) concluded that the system was dominated by wildlife impacts, ranging from 35% to 72%. The next largest source was found to be livestock, at 12% to 30%. Dogs (4% to 24%) and humans (2% to 17%) were lower, but typically above the minimum detection levels.

4.2 Modeling

The BASINS Nonpoint Source Model (NPSM) and the Hydrologic Simulation Program-FORTRAN (HSPF) were used to simulate flow and the fate and transport of fecal coliform bacteria in the Moore's Creek watershed. These models incorporate temporal and spatial variability within the watershed.

Due to a minimal amount of flow observations from Moore's Creek, an equivalent watershed approach and synthetic flow generation were used to calibrate the hydrological component of the models. The Buck Mountain Run watershed within the Rivanna drainage system was selected as an equivalent watershed, although a little less developed. The HSPF/NPSM model was calibrated to the Buck Mountain Run watershed for the five-year period between 10/1992 and 9/1997. A synthetic flow generator that combined an artificial neural network and a maintenance of variance approach (ANN + MV) was developed and demonstrated on the Buck Mountain Run watershed. The synthetic flow generator was then applied to the Moore's Creek system to create flow predictions for the period over which significant water quality and flow observations exist (10/1996 to 8/2001). The synthetic flow predictions not only accurately reproduced the observed flows on Moore's Creek, but also provided a continuous calibration target for the NPSM/HSPF model on Moore's Creek. NPSM/HSPF parameters for the Buck Mountain Run watershed were adjusted to accurately reproduce the synthetic flows for the 5-year period.

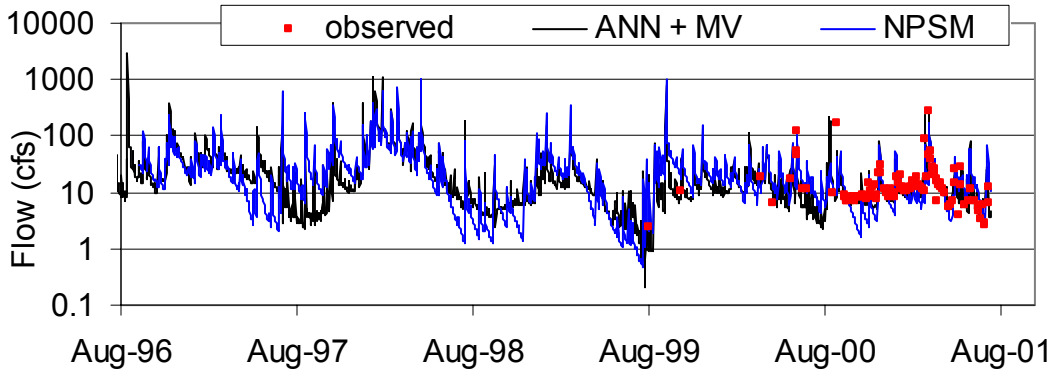

Fig. 4.2 Comparison of NPSM predictions, synthetic flows and observed flows for Moore's Creek

The water quality model was then calibrated to the observed fecal coliform concentrations over the same 5-year period. The fecal coliform loads applied directly to the stream and to the land surface were calculated on a monthly basis to account for seasonal variability in wildlife populations and the varying time that cattle spend in the stream.

4.3 Results for Existing Conditions

Water quality predictions during the calibration period presented that under current conditions the instantaneous standard would be violated 18% of the time and the 30-day geometric mean criterion of 200 cfu/100ml would be violated 62.8% of the time. Of the bacteria that reached the stream, 40.1% were from wildlife, 34.1% from livestock, 19.4% from dogs, and 6.4% from human sources, although the relative proportions of these sources may shift, dependent on whether the stream was at low or high flows and with season.

4.4 Margin of Safety

The fecal coliform load in the TMDL is divided into three categories. One is the margin of safety (MOS). A margin of safety will be explicitly added by achieving concentrations 5% below the 30-day geometric mean criterion of 200 cfu/100 ml. The remaining allowable 190 cfu/100ml is divided between the allowable loading from point sources (termed the waste load allocation, WLA) and the allowable loading from nonpoint sources (termed the load allocation, LA).

4.5 TMDL Allocation Scenarios

Establishment of a TMDL is meant to provide a loading that will be protective of water quality in the future. Thus, future conditions were used for determination of the allowable load. Assumptions related to human population increase and land use changes were consistent with the current population growth rate of the county and the county development area plan.

For the base case for future land-based nonpoint source loads, the fecal coliform loading rates (counts/acre/month) for most land uses were held constant with the rates from the current conditions. The exception was for grasslands, which included pastures. Due to a rapid decline in livestock populations, the loading rate used for grasslands during the calibration period was not representative of the anticipated loading in the future. Therefore, the loading rate for grasslands for the base case was modified to be consistent with the 2002 population and distribution of livestock within the watershed. Overall, the grassland loading rates under future conditions averaged 53% of those used during the calibration period.

For the base case, future loads of coliform bacteria deposited directly in Moore's Creek will come from four sources: the two point sources and cattle and wildlife in the stream. Both point sources were modeled as discharging at their maximum permitted concentration of 200 cfu/100 ml and their expected average outflows. With the increase in population, the future average outflow from the Moore's Creek wastewater treatment

plant increases to 12 million gallons per day, while the flow volume from Southwood facility remains unchanged. The direct load from cattle in stream was also reduced due to loss of livestock from one of the stream access areas. Wildlife deposition directly to the stream was assumed unchanged from that determined for the present case simulations. Although some modifications to the wildlife populations and distribution are expected to be induced by land use alterations, some wildlife populations will decrease while others will increase. Thus changes in wildlife numbers tend to offset, leaving only a small impact, relative to the model uncertainty, on the total wildlife load deposited directly in the stream.

TMDL allocation scenarios were then generated by reducing the base case loads. The first step in building an allocation scenario was removal of all non-permitted human bacterial loads (straight pipes, sewer system leakage, and failing septic systems) and exclusion of cattle from the stream. These changes alone are insufficient to meet the TMDL goal. However, since untreated human waste should not be reaching the stream and allowing livestock access to the stream is an inappropriate management practice, these two steps were assumed in all other scenarios. Furthermore, adding extreme reductions in the remaining land-based loads from human activities was insufficient to meet the TMDL target.

In order to meet the TMDL target, a TMDL allocation that reduced both the direct wildlife loads to stream and the remaining land-based nonpoint source loads was developed. Reduction levels varied by subwatershed and by land use. Table 4.2 shows the recommended load reductions to meet the TMDL goal. As in previous scenarios, all non-permitted human sources were removed and cattle were removed from the stream. Some subwatersheds show zero reductions in one or more of these sources simply because there were no such sources in the subwatershed under base case conditions. Residential reductions were assigned to developed subwatersheds along or near the main stem of Moore's Creek. Reductions in grassland loads were assigned to subwatersheds that still held significant numbers of livestock. The high percentage reduction to grasslands in subwatershed 9 assumes that the feral goat population will be removed and that best management practices will be put in place around the stockyard. For subwatersheds with a significant urban area, urban contributions were reduced from 45% to 50%, with the highest reductions assigned to the subwatersheds near the main stem of Moore's Creek.

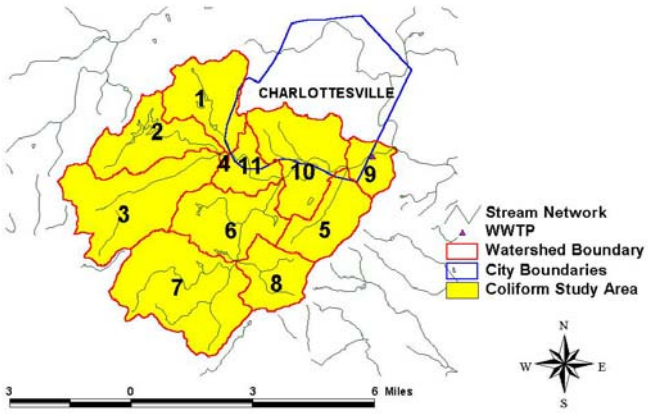

Fig. 4.3 TMDL subwatersheds

Table 4.2. TMDL load reductions for the Moore's Creek watershed. (SW# indicates subwatershed number.)

	Percentage Reductions in Contributions from:									
						Other NPS: By Land Use				
SW#	Direct Cattle	Straight Pipe	Septic NPS	Sewer Leak-age	Direct Wildlife	Forest	Low-Density Resid.	Med-Density Resid.	Grass-land	Urban
1	0	100	100	100	40	0	0	0	0	45
2	0	0	100	0	40	0	0	0	0	45
3	100	100	100	0	40	0	0	0	30	45
4	0	0	0	0	40	0	0	0	0	0
5	0	0	100	100	40	0	30	30	30	50
6	0	100	100	100	40	0	40	40	30	45
7	0	100	100	0	40	0	0	0	30	0
8	0	0	100	0	40	0	0	0	30	0
9	0	0	100	100	40	0	50	50	85	50
10	0	0	0	100	40	0	50	50	0	50
11	0	0	0	100	40	0	50	50	0	50

The corresponding TMDL load allocations for the Moore's Creek watershed are shown in Table 4.3. The allocations are based on the total contributions to the stream. Each point source is allocated its permitted waste load allocation (WLA). The contribution from the Southwood Mobile Home Park (permit number VA0029955) load, at 200 cfu/100 ml and an average outflow of 39,000 gallons/day, is shown under WLA(SW), while the contribution from the Moore's Creek Advanced Wastewater Treatment Plant (permit number VA0025518) load, at 200 cfu/100 ml and an average flow of 12 million gallons per day, is shown under WLA(MC). These allocations require no reduction from the permitted point source loads, although any permit violations are assumed eliminated. Table 2 also shows the total allocation to nonpoint sources (SLA) and the load reserved as a margin of safety (MOS). To meet this TMDL, the required reduction of all nonpoint source contributions (direct to stream and land based; human controlled and background) is 31.8% compared to current contributions or 34.6% compared to the base case future contributions.

Table 4.3. TMDL load allocations (cfu/day)

WLA(SW)	WLA(MC)	ΣLA	MOS[a]	TMDL
0.01×10^{13}	3.30×10^{13}	61.41×10^{13}	3.41×10^{13}	68.13×10^{13}

[a]Five percent of the TMDL

5.0 Public Participation

Involvement in the implementation plan included two public meetings and the participation of a technical committee. Several members of the technical committee were recruited by calling appointed local government officials, telling them about the implementation plan, inviting them to the first public meeting, and asking them to name an appropriate staff person to the committee. Others joined the committee due to the IP's relationship to their work or simply due to their own interest. Formation of the technical committee began before the first public meeting.

5.1 Public Meetings

The first public meeting was held November 17, 2003 at the TJPDC offices in downtown Charlottesville. The public notice for this meeting appeared in the Virginia Register on November 3, 2003. The meeting was also advertised by posting a notice on the TJPDC website, by e-mailing a large distribution list including elected and appointed officials and representatives of numerous environmental groups, by getting listings in local events calendars, and by mailing a letter to every landowner along Moore's Creek or one of its major tributaries. Presentations by Robert Brent of DEQ, Rochelle Garwood of TJPDC, and Michael Bowman of DCR covered background information on the TMDL, the parts of an implementation plan, and elements for a successful implementation plan. About 15 people attended, primarily members of the technical committee. Copies of the presentation materials were available at the meeting and were posted on the TJPDC website afterwards. The public comment period ended on December 17, 2003. No written comments were received.

The second public meeting was held December 9, 2004, also at the TJPDC offices. This meeting was advertised in the Virginia Register on November 15, 2004. The meeting was publicized through signs in the watershed, radio public service announcements, listings in local newspapers' calendars, an e-mail to the previously-mentioned distribution list, and an announcement at a well-attended presentation concerning Charlottesville's streams. Despite these efforts, the meeting was attended solely by members of the technical committee and PDC, DEQ and DCR staff. Following the formal presentation of the draft plan, the discussion period gave the technical committee an opportunity to discuss issues with state agency staff, particularly regarding implementation funding.

5.2 Technical Committee

Members of the technical committee included representatives from Albemarle County, the Albemarle County Service Authority (ACSA), the City of Charlottesville, the Albemarle and Virginia Farm Bureaus, The Nature Conservancy (TNC), the Rivanna Water and Sewer Authority (RWSA), the Southern Environmental Law Center, the Thomas Jefferson Soil and Water Conservation District (TJSWCD), the University of Virginia (UVA), and the Virginia Department of Health (VDH), as well as a local developer and an interested citizen from the Belmont neighborhood.

The initial technical committee meeting was a little over a week after the public meeting,

on November 26, 2003. At this point the committee was still not fully formed, and one of the primary discussion topics was additional membership. Other organizational topics included the formation of subcommittees, but the technical committee members felt that the technical committee would never be sufficiently large to support breaking into smaller groups, and that too many of the members had interests that would cross subcommittee boundaries. The convening of a citizens' committee was considered as a possibility for later in the process, when the committee would have something to use as a point of discussion. The TMDL allocations by subwatershed were reviewed, sample IPs from other watersheds were discussed, and a table of allowable BMPs from the Guidance Manual for Total Maximum Daily Load Implementation Plans was distributed. Members were encouraged to bring plans to the next meeting that their agencies had already completed that intersected with the IP.

At the next meeting, on January 7, 2004, the committee welcomed several new members. The primary topic of the meeting was Albemarle County's Stream Assessment, in which County staff walked approximately 100 miles of stream corridor, including Moore's Creek and many of its tributaries, and documented items that may contribute to stream degradation including erosional areas and questionable-looking discharge pipes.

By the February 20, 2004 meeting, a sufficient number of plans had been assembled to create a first draft of a table of BMPs for the Moore's Creek watershed. This table and possible additions were the major topics of discussion for the meeting. Members also looked over maps of bacterial counts and source tracking results from the bacterial source tracking study (Wiggins, 2001), but were baffled by the high percentage of bacteria attributed to goats. The committee concluded that the majority of bacteria attributed to goats must have been coming from elsewhere.

On April 15, 2004, the committee reviewed an expanded BMP table and discussed whether it was time to convene a citizen's committee. The consensus, however, was that there was little to be added to the table and that the most important consideration to be addressed by citizens was their receptivity to the proposed BMPs where they were directly affected. The committee decided that it was best to address that with the specific stakeholders that would be affected.

The May 5, 2004 meeting was a wrap-up on the BMP table and a discussion of funding sources. The stream buffer and restoration projects resulting from the Albemarle stream assessment appeared to have the most options for funding, with septic rehabilitation and sewer extension being among the more difficult. Results of a field survey of livestock in the watershed were reported; considerably fewer livestock were found in 2004 than had been reported in the TMDL. A subcommittee was created to look more closely at the stream buffer and restoration projects and potential livestock BMPs, some of which appeared likely to be co-located.

The final meeting of the technical committee was on October 19, 2004. The first draft of the IP was the major topic for discussion. Initial comments were received, and committee members encouraged to e-mail more detailed comments, which many did.

6.0 Implementation Actions

Because land uses in the Moore's Creek watershed cover the full range from rural to suburban to urban, implementation actions to be taken in the watershed likewise cover the full spectrum of practices. Proposed actions include agricultural BMPs, stream bank protection and stabilization, stormwater BMPs, sanitary sewer system improvements, septic problem and straight pipe detection and funding assistance programs, education programs, planning activities, and maintenance. Some of these actions are outlined in previously written plans; others are new actions proposed directly as a result of the TMDL.

6.1 Agricultural BMPs

The TMDL calls for the removal of all cattle from the stream, and a reduction in inputs from grassland of 30% (85% for the subwatershed containing the stockyard). A field survey of livestock was conducted in order to determine the location of cattle and other livestock in the watershed. The results of the field survey of livestock were used to target parcels that would benefit from the application of agricultural BMPs such as alternative watering systems, stream fencing and buffer planting. Animal exclusion has a 75% bacterial removal efficiency, while installation of forested buffers results in 43-57% removal of bacteria (TMDL Implementation Plan Guidance Manual). The owners of the identified parcels will be approached by the TJSWCD with regard to participating in the voluntary cost-share programs administered by the SWCD for the installation of BMPs. Since the field survey parcels plus the stockyard constitute all known locations of livestock in the watershed, 100% participation in the BMP programs should result in the desired reductions from cattle and grassland. Some of the parcels identified were also the sites of buffer projects identified by the Albemarle County Stream Assessment Project; additional buffer projects were identified on other pasturelands, which did not have animals in evidence at the time of the livestock survey but may be used at times.

Figure 6.1 Alternative watering system

In January 2005, the Charlottesville stockyard received a notice of violation from DEQ. Issues cited included manure stored in close proximity to the creek, a hog penned within a tributary channel, an exposed and broken sewer or drainage pipe, drainage problems with the stockyard building, and the improper disposal of animal carcasses. DEQ is working with the owner and manager of the property to put together a plan to resolve the situation. The intent is to work under a Letter of Agreement rather than a consent order, so as to leave the door as open as possible for funding, although TJSWCD staff has not been able to identify an appropriate funding source.

Cost estimates in Table 6.1 and the stockyard estimate in Table 6.2 were supplied by the TJSWCD based on general knowledge of the types of BMPs needed These estimates are

likely to be refined following individual site visits and consultation with the landowners. The stockyard estimate in particular may vary depending on the final plan agreed upon by the owner and DEQ. Cost estimates in Table 6.2 were supplied by Albemarle County staff based on individual site visits.

Table 6.1 Agricultural projects identified through field survey

Animal Units	Also IDed by Albemarle County	BMPs Needed	BMP Units Needed	Sub-watershed	Cost Estimate	Potential Funding Source
16 cattle 4 horses (2 separate parcels)	No	Fencing, buffer, alternative watering system, stream crossing	4,978' fencing, 11 acres buffer, 2 ea. watering facilities, wells and stream crossings, 2000' pipeline	2	$42,581	VA Agricultural Cost-Share through TJSWCD, CREP, EQIP, VA Aquatic Resources Trust Fund, WHIP, EPA Section 319
25 cattle	No	Fencing, buffer, alternative water system, stream crossing	10,100' fencing, 23 acres buffer, 2 watering facilities, 1 ea. well and stream crossing, 1000' pipeline	3	$58,785	VA Agricultural Cost-Share through TJSWCD, CREP, EQIP, VA Aquatic Resources Trust Fund, WHIP, EPA Section 319
32 cattle	Yes	Fencing, buffer, alternative water system, stream crossing	4400' fencing, 10 acres buffer, 2 watering facilities, 1 ea. well and stream crossing, 1000' pipeline	5	$34,620	VA Agricultural Cost-Share through TJSWCD, CREP, EQIP, VA Aquatic Resources Trust Fund, WHIP, EPA Section 319
47 horses 2 donkeys	Yes	Fencing, buffer, alternative water system, stream crossing	1600' fencing, 3.7 acres buffer, 2 watering facilities, 1 ea. well and stream crossing, 1000' pipeline	6	$22,815	VA Agricultural Cost-Share through TJSWCD, CREP, EQIP, VA Aquatic Resources Trust Fund, WHIP, EPA Section 319
25 cattle	No	Fencing, buffer, alternative water system	2055' fencing, 2.9 acres buffer, 1 ea. watering facility and well, 1000' pipeline	7	$18,222	VA Agricultural Cost-Share through TJSWCD, CREP, EQIP, VA Aquatic Resources Trust Fund, WHIP, EPA Section 319
15 horses	No	Fencing, buffer, alternative water system	887' fencing, 0.7 acres buffer, 1 ea. watering facility and well, 1000' pipeline	8	$13,624	VA Agricultural Cost-Share through TJSWCD, CREP, EQIP, VA Aquatic Resources Trust Fund, WHIP, EPA Section 319
Total Cost Estimate:						$190,647

Table 6.2 Other projects on agricultural land

Project Location	BMPs Needed	BMP Units Needed	Sub-watershed	Cost Estimate	Potential Funding Source
Charlottesville stockyard	Fencing, buffer, alt. watering system, and manure storage facility	2065' fencing, 1 ea. watering facility and waste storage facility	9	$28,543	Section 319
Pasture midway bet. Wingfield Brook & unnamed tribs	Stream buffer	800 linear ft (right side)	8	$18,147	VA Aquatic Resources Trust Fund, WHIP, Small Watershed Grants, Section 319
Pasture above conf. w/Moore's Ck	Stream buffer	400 linear ft (left side)	1	$10,323	VA Aquatic Resources Trust Fund, WHIP, Small Watershed Grants, Section 319
Pasture near Bellair	Stream buffer	300 linear ft (left side)	1	$8,368	VA Aquatic Resources Trust Fund, WHIP, Small Watershed Grants, Section 319
Total Cost Estimate:					$65,381

The total estimated cost for animal exclusion and buffers is $256,028. Note that this cost estimate is for physical installations only, and does not include costs for technical assistance and administration. If the costs of technical assistance and administration hold to a similar ratio as was used in the IP for the North Fork/South Fork/Upper/Middle Blackwater Rivers (i.e. ~27%), technical assistance and administration costs would add approximately $69,000, for a total of ~$325,000. As discussed, these projects should meet the TMDL goals of 100% exclusion of livestock from streams and 30% reduction of inputs from grasslands. The 85% reduction of grassland inputs in subwatershed 9 are expected to be achieved through the BMPs implemented at the Charlottesville stockyard under a Letter of Agreement between DEQ and the owner.

6.2 Stream Bank Protection and Stabilization

Stream bank protection and stabilization projects have been found to be 40-75% efficient for bacterial removal (40% without fencing, 75% with fencing; TMDL Implementation Plan Guidance Manual). Two studies, the Albemarle County Stream Assessment Program and the Rock Creek Stream Valley Master Plan, have made detailed assessments of stream restoration work and protection needed. However, the Rock Creek plan did not make assessments of feasibility or priority, and the budget for the entire stream valley of over $1 million proved to be too much for Charlottesville and UVA, the study's sponsors. Further study would be needed to determine whether any of the restoration projects

Fig. 6.2 A section along the main stem of Moore's Creek

outlined in the plan would be practical. Charlottesville is currently having a stream assessment performed that will include Rock Creek as well as Lodge Creek and Pollock's Creek, also tributaries of Moore's Creek. It is expected that erosion, inadequate buffers, and pipe outfalls, among other characteristics, will be noted and that a priority list will be developed for implementation projects. Already, a leaking private sanitary pipe has been discovered and replaced along Pollock's Branch. The full results of the study are expected by mid-2005, and may indicate additional stream bank protection or other types of projects that should be considered.

Albemarle's Stream Assessment program considered severity, feasibility, and consistency with master plans and community goals. Those projects that rated highest are listed below. Cost estimates are from Albemarle County staff. The majority of these projects are on pasture lands (some are co-located with buffer and fencing projects) and would provide additional protection from the effects of livestock. The Moore's Creek project just downstream of Azalea Park is along a hiking trail that is heavily used by dog walkers. This project would contribute to the reductions from residential loads called for in subwatershed 11.

Table 6.3 Stream bank protection and stabilization projects from stream assessment

Proposed BMP	Description	Entity/ Source	Stream Frontage	Sub-watershed	Estimated Cost	Potential Funding Source
Biscuit Run erosion control	Below conf. w/Wingfield Brk	Alb Co SA & SMP	60 linear ft (left side)	6	$24,787	VA Aquatic Resources Trust Fund, Streambank Stabilization Cost-Share Program, Small Watershed Grants, Section 319
Biscuit Run erosion control	Unnamed trib near Forest Lodge Ln	Alb Co SA & SMP	150 linear ft (both sides)	6	$90,105	VA Aquatic Resources Trust Fund, Streambank Stabilization Cost-Share Program, Small Watershed Grants, Section 319
Morey Creek erosion control	Above conf. w/Moore's Ck	Alb Co SA & SMP	80 linear ft (left side)	1	$26,287	VA Aquatic Resources Trust Fund, Streambank Stabilization Cost-Share Program, Small Watershed Grants, Section 319
Morey Creek erosion control	Near Buckingham Circle	Alb Co SA & SMP	900 linear ft (both sides)	1	$313,637	VA Aquatic Resources Trust Fund, Streambank Stabilization Cost-Share Program, Small Watershed Grants, Section 319
Morey Creek erosion control	Below Bellair	Alb Co SA & SMP	500 linear ft (both sides)	1	$124,974	VA Aquatic Resources Trust Fund, Streambank Stabilization Cost-Share Program, Small Watershed Grants, Section 319

Table 6.3 cont.

Proposed BMP	Description	Entity/ Source	Stream Frontage	Sub-watershed	Estimated Cost	Potential Funding Source
Morey Creek erosion control	Near Bellair	Alb Co SA & SMP	150 linear ft (left side)	1	$23,756	VA Aquatic Resources Trust Fund, Streambank Stabilization Cost-Share Program, Small Watershed Grants, Section 319
Moore's Creek erosion control	Below Azalea Park	Alb Co SA & SMP	600 linear ft (right side)	11	$127,359	VA Aquatic Resources Trust Fund, Small Watershed Grants, Section 319
Total Cost Estimate:						$730,905

Because of the high cost of many of these projects and the estimate that the projects in section 6.1 should be adequate to reduce impacts from livestock and grasslands, these projects should generally be considered secondary to the projects in Section 6.1, to be implemented if the projects in 6.1 are not all able to be installed, do not adequately reduce livestock/grassland inputs, or if these projects can be done less expensively in conjunction with the projects in Section 6.1. One exception to this may be the project on the Moore's Creek mainstem as it would address a dog/urban impact, but more study would be needed to determine the potential effect of the project.

6.3 Stormwater Best Management Practices

The TMDL calls for a reduction in contributions from urban land uses of 45-50% and reductions from residential land uses of 30-50%. One way to address runoff from urban and residential land uses is by the use of stormwater best management practices. Both Albemarle County and Charlottesville now have ordinances that require the use of stormwater BMPs for new development. The urban part of the watershed, by its very nature of being urban and therefore tightly developed, will be challenging to retrofit. Two initiatives, the 1996 Moore's Creek Watershed Study and the 2002 Albemarle County Stormwater Management Master Plan, were unable to identify any locations for regional stormwater BMPs to mitigate existing development. On existing urban lands, the reductions called for in the TMDL will be achieved through sanitary sewer and septic system improvements (see Sections 6.4 and 6.5), educational programs (see Section 6.6), projects resulting from planning activities (Section 6.7), and maintenance activities (Section 6.8) rather than through regional stormwater BMPs.

Fig. 6.3 Biofilter at Monticello High School, in the Moore's Creek watershed

The University of Virginia, as a state agency, is required to implement stormwater BMPs for land disturbance projects and this activity is approved and monitored by the DCR. Through this program, the University developed a comprehensive stormwater management master plan for the portions of the Moore's Creek watershed that lie within the campus boundaries. This plan takes into account past, current, and planned projects and divides the watershed into sub-basins so that impacts to individual tributaries to Moore's Creek can be managed and in some cases reduced. All new development on the university campus must meet quantity and quality limits established by this master plan. The plan also focuses on watershed restoration opportunities that can be incorporated into future development activities. The University intends to construct a number of stormwater BMPs in the Moore's Creek watershed over the next several years as the university expands its health sciences and academic facilities on the south side of the campus. As outlined in the master plan, these BMPs would likely include daylighting of streams; creation of wetlands, ponds and floodplains; vegetated buffers; and infiltration galleries. Specifics were unavailable at the time this plan was written, but it is expected that the BMPs, although primarily designed to mitigate new construction, will also in some cases provide treatment over and above that which is needed for the new construction. UVA's proposed 2005 budget includes $100,000 for stormwater management implementation in the Moore's Creek watershed.

6.4 Sanitary Sewer System Improvements

The TMDL calls for 100% removal of sewer leakage. Charlottesville Public Works has several projects, both ongoing and planned, which will decrease infiltration/exfiltration and overflows. These projects include manhole relining, smoke/dye testing of sewer lines, and upgrading the line serving UVA's Scott Stadium, which is a known source of sanitary sewer overflows. Estimates for costs of these projects were provided by Charlottesville staff. UVA also recently spent $1.2 million to reline the sewage surge tank located at Scott Stadium. Additionally, Charlottesville has initiated an effort (October 2004) that will provide necessary information to comply with proposed Capacity, Management, Operations and Maintenance (CMOM) requirements found in Section 122.42(e)(2) of the Federal Register.

The Albemarle County Service Authority (ACSA) reports that the majority of their infrastructure in the Moore's Creek watershed is less than 20 years old. Although they anticipate spending between $200,000 and $500,000 a year over the next 10 years on inflow and infiltration (I&I), most of the focus will be outside of the Moore's Creek basin. Infrastructure investments in the basin will primarily be providing service to areas with failing drainfields. This will assist in addressing the 100% reduction in non-point source pollution (NPS) from septic systems called for by the TMDL. ACSA has several projects listed in its Capital Improvement Plan (CIP) that would address areas in the Moore's Creek should they be identified as problems. The first project, involving extension of sewer to the Southwood Mobile Home Park (MHP) package plant, has already been completed. The plant is scheduled to connect to the public sewer before the end of 2004. This plant serves approximately 195 mobile homes and is under a consent decree due to permit violations for flow volume, total suspended solids, and biological oxygen demand. The consent decree requires that Southwood complete repairs on the

system to prevent inflow and infiltration and hook up to the public sewer no later than 180 days after plans are approved for the facility bypass. It then has 180 days to close its package plant completely.

Also in the Service Authority's CIP are collection system projects for several subdivisions in the Moore's Creek Basin. The first is within the Oak Hill subdivision, an older area that contains 75 drainfields adjacent to Biscuit Run. ACSA staff has indicated that this project is the most important in terms of addressing failing septic fields, saying that more complaints come from this neighborhood than the others combined. However, construction depends on commitments from the homeowners as well as supplemental financing to become a reality. Three other projects, potentially serving 305 aging drainfields, are listed in the CIP but are also subject to homeowner and financing limitation. The cost of the Oak Hill project is estimated at $1.2 million; total cost of all four proposed projects is estimated at $4.7 million (all cost estimates are from the CIP).

Table 6.4. Sanitary sewer system improvements

Proposed BMP	Entity/Source	Scheduled	Area Treated	Sub-watershed	Estimated Cost	Potential Funding Source
Increase size of Valley Road collector line	Charlottesville Public Works	Flow monitoring to begin in March		10	$1,000,000	Charlottesville
Upgrade Stadium line	Charlottesville Public Works	Construction in 2005	1,080 ft	10	$3,200,000	Charlottesville
Manhole relining	Charlottesville Public Works	Continuing	30% need relining; about 2/3 complete	10	$4,200,000 for I&I activities*	Charlottesville
Smoke/dye testing of sewer lines	Charlottesville Public Works	Continuing; estimated completion about 10 years	City Basin 12 (bet. Avon St. & Monticello Rd.) complete. Basin 18 (adjacent to mainstem) next.	10		Charlottesville
Sewer line maintenance and inspection	UVA	Continuing			$50,000/yr; estimate $500,000/10 yrs.	UVA
Biscuit Run oversizing/ Southwood connection	ACSA CIP/DEQ consent decree	Constructed 2004; connection of Southwood by 2005	180 trailers (for package plant)	6	NA	ACSA/Owner
Oak Hill sewer	ACSA CIP & homeowners	As funds become available	75 drainfields	6	$1,210,000 (may be built in sections)	CDBG, Section 319, ACSA, SERCAP, homeowners

Table 6.4 cont.

Proposed BMP	Entity/Source	Scheduled	Area Treated	Sub-watershed	Estimated Cost	Potential Funding Source
Bellair Liberty Hill sewer	ACSA CIP & homeowners	As needed	105 drainfields	1	$1,093,000 (may be built in sections)	ACSA, homeowners
Ednam Forest sewer	ACSA CIP & homeowners	As needed	140 drainfields	1	$2,014,000 (may be built in sections)	ACSA, homeowners
Stagecoach Rd/Forest View/Country Green/Oak Hill Trailer Park ext.	ACSA CIP & homeowners	As needed and as funds become available	33 drainfields + 1 community drainfield for 19 trailers	6, 11	$806,525	CDBG, Section 319, ACSA, SERCAP, homeowners
Buckingham Circle sewer	ACSA CIP & homeowners	As needed	60 drainfields	1	$344,000 (may be built in sections)	ACSA, homeowners
Total Cost Estimate:						$14,367,525

* The City spends $1.2 M annually on I&I activities (although not all is for testing/relining) across the entire City. Assuming that over a 10-year period effort would be spent in the Moore's Creek watershed approximately proportionate to its 35% coverage of the city, $12M*0.35 = $4.2M.

6.5 Septic Systems and Straight Pipes

As previously mentioned, the TMDL called for 100% reduction in septic NPS; 100% reduction in straight pipes (pipes discharging directly to the stream) was required as well. The TMDL estimated 209 failing septic systems and seven straight pipes in the watershed. This included 63 in subwatershed #1, which would be covered by the last three projects in the previous table, and 28 in subwatershed #6, all of which would be in Southwood, Oak Hill, or one of the other areas proposed for sewer service. This leaves an estimated 118 failing septic systems in the watershed that will not be able to be addressed by public sewer hook-ups, nor is it expected that straight pipes are to be found in the proposed sewer extension areas. Detection methods will need to be developed, as well as assistance plans, as many of the homes with failing septic systems or straight pipes may be unable to afford to correct them. The Thomas Jefferson Soil and Water Conservation District will develop an assistance program if funding can be secured. Estimated cost ranges for septic system replacement vary from $3,000-$7,000 (National Small Flows Clearinghouse, 1995) to $6,000-$20,000 to replace a failed drainfield (www.septic-info.com, citing 2002 information from U.S. Inspect). In general, drainfield system replacement costs are greater if an alternate drainfield site is not available. This is the case in a number of older subdivisions, which adds to the desirability of connecting them to the public system. If it were assumed that most of the remaining failed septic systems were on rural lots with adequate space for an alternate drainfield, a conservative estimate for the cost of replacement of the 118 septic systems and seven straight pipes

would be 118 x $6,000 = $708,000. Education is another need in this area; many owners are unaware of the need for regular pumping and system maintenance. Purchasers of existing homes on septic systems may not even be aware that their homes are on them. The TJSWCD is interested in developing a septic education program, should funding become available.

A major concentration of failing septic systems is located within the Southwood MHP. Four systems serving 12-20 mobile homes have been identified to date and are being required by the Virginia Department of Health (VDH) to be pumped according to a system that sounds an alarm when the capacity of the septic tank is reached. This is a temporary solution; permanent repair must take place within 12 months.

Fig. 6.4 Failed drainfield at Southwood MHP

Southwood will be required to hire an engineer to assess the site and draw up plans to be approved by VDH. Because of the age of the systems, it is expected that there will be other system failures in the MHP (which contains approximately 180 mobile homes served by septic) in coming years. Connection to the sewer system appears unlikely under current ownership.

Estimates in the following table were made by TJSWCD and TJPDC staff.

Table 6.5 Septic systems and straight pipes

Proposed BMP	Entity/Source	Area Treated	Sub-watershed	Estimated Cost	Potential Funding Source
Pumping/repair of failing septic systems at Southwood	VDH, Owner	Currently about 12-20 mobile homes; others expected to be failing or on verge	6	Unknown, but must be fully financed by owner	Owner
Develop plan for failing septic system and straight pipe detection	Albemarle, Charlottesville, TJSWCD, TJPDC, VDH		all	$10,000	Albemarle, Charlottesville, Section 319
Develop funding assistance program for septic problems/straight pipes	TJSWCD		1-3, 5-9	$9,000 for program development; ~$708,000 for system replacements	Section 319, SERCAP, owners
Develop education program for septic owners	TJSWCD		all	$6,000	Small Watershed Grants, Section 319
Total Cost Estimate:					$733,000

6.6 Urban/Residential Education Programs

Albemarle, Charlottesville and UVA all have included public education and outreach as part of the control measures in their NPDES (National Pollutant Discharge Elimination System) Phase II Stormwater Permits. One of the primary activities is a collaborative one – the formation of a stormwater education partnership and website which includes Charlottesville, Albemarle, UVA, RWSA and VDOT. Other education activities include presentations to groups, development of brochures and fact sheets, and work with the schools to dovetail stormwater and water quality education with Standards of Learning.

Albemarle County has contracted with the TJSWCD to fulfill its public education, outreach, and involvement components. Albemarle County will additionally be developing educational materials for BMP owners, and the TJSWCD is interested in the development of an education program for septic system owners, should funds become available. Other critical needs for education include pet waste management and appropriate wildlife interaction (for example, feeding the geese found at many of the ponds in the watershed encourages greater populations of geese than the ponds can reasonably sustain). All of these programs are currently limited in terms of the funding and staff time devoted; for example, pet waste education receives only about $250 per year from the City of Charlottesville. The education partnership recently spent $2,000 on a storm drain marking program designed to educate the community on where its stormwater goes. Additional funding through grants would enable the expansion of these programs to reach a greater audience.

Fig. 6.5 Appropriate dog walking practices

Table 6.6. Urban/Residential Education Programs

Proposed BMP	Entity/Source	Comments	Estimated Cost	Potential Funding Source
Public education on pet waste management	Charlottesville, Albemarle, UVA, TJPDC	Consider new initiatives such as putting baggies in utility bills	$72,500 (over 10 years)	Charlottesville, Albemarle, UVA, Section 319, Small Watershed Grants
Stormwater education partnership and website	Charlottesville, Albemarle, UVA, RWSA, VDOT, TJSWCD	TJSWCD will maintain website	$72,000 (over 10 years)	Partners
Utilize website to register, track, and address citizen complaints regarding stormwater issues	TJSWCD		$30,000 (over 10 years)	Albemarle

Table 6.6 cont.

Proposed BMP	Entity/Source	Comments	Estimated Cost	Potential Funding Source
Utilize local media to promote awareness	Charlottesville, Albemarle, UVA		$36,750 (over 10 years)	Charlottesville, Albemarle, UVA
Dovetail stormwater and water quality education with SOLs	Albemarle, TJSWCD, Charlottesville	Major initial effort completed (development and distribution of a Water Resources Binder to support curriculum). TJSWCD will work with Albemarle County schools.	$5,375 (one-time cost)	Albemarle, Charlottesville
Develop menu of stormwater/watershed lesson plans and provide staff to guide teachers' use	TJSWCD		$7,000 (one-time cost)	Albemarle
Conduct teacher workshop for incorporation of stormwater/watershed education into curriculum	TJSWCD		$5,000 (one-time cost)	Albemarle
Coordinate/schedule use of watershed model in local middle schools (public & private)	TJSWCD		$30,000 (over 10 years)	Albemarle
Organized education on stormwater	Charlottesville, Albemarle, UVA, TJSWCD		$44,750 (over 10 years)	Charlottesville, Albemarle, UVA, Small Watershed Grants
Develop mailing list of homeowners' association contacts	TJSWCD		$1,000 (one-time cost)	Albemarle
Develop brochures & fact sheets for distribution to homeowners associations, youth groups, & the development community	TJSWCD		$9,000 (one-time cost)	Albemarle
Develop educational materials for BMP owners	Albemarle County		$5,000 (one-time cost)	Albemarle
Continue & expand Adopt-A-Stream Program and storm drain stenciling program with youth groups and citizen groups	TJSWCD		$65,000 (over 10 years)	Albemarle
Total Cost Estimate:				$383,375

6.7 Planning Activities

Again as a result of NPDES Phase II, Charlottesville, Albemarle and UVA have increased emphasis on stormwater planning. As stated above, UVA has already developed a stormwater master plan and is in the process of implementing and integrating it into the University's long-range development plans. Albemarle is still working on a watershed master plan and watershed action lists. Charlottesville has reviewed, amended, and adopted City Code addressing improvements to the erosion and sediment control program, stream protection (including the establishment of a 100-foot buffer along Moore's Creek), stormwater management, and illicit discharge detection and elimination. All three entities are committed to using new development and redevelopment as opportunities for stream restoration and regional BMPs. As an example, UVA recently spent approximately one million dollars from a new basketball arena project to daylight and reconstruct two tributaries to Meadow Creek on the west side of campus.

Note that planning activities will in turn generate additional implementation projects, which cannot be estimated at this time. For example, Charlottesville's water quality planning study is projected to be completed within the next few months. The study will offer an initial look at where opportunities lie for restoration of stream health. It is anticipated that a second phase will be carried out which will consider costs and benefits of various measures that could be taken. Implementation measures will depend on the results of that analysis but may include targeted education, site development requirements or stream restoration. Section 319 funding will be sought for these activities as appropriate.

Table 6.7. Planning activities

Activity	Entity	Subwatershed	Estimated Cost	Potential Funding Source
Complete stormwater master plan and watershed action lists	Albemarle County	all	$873,000*	Albemarle
Reviewed and amended City code for adequate coverage of issues including erosion and sediment control, stream protection, stormwater management, and illicit discharge	Charlottesville	9, 10, 11	complete	Charlottesville
Adopt design standards that improve erosion and sediment control, stream protection, and stormwater management	Charlottesville	9, 10, 11	$4,000	Charlottesville
Continue to revise and improve stormwater master plan	UVA	10	$50,000 (FY2005, for major revision; future costs unprojected)	UVA
Conduct a City-wide watershed-based water quality planning effort	Charlottesville	9, 10, 11	$90,000	Charlottesville, U.S. Army Corps of Engineers

Table 6.7 cont.

Activity	Entity	Subwatershed	Estimated Cost	Potential Funding Source
Use new development/ redevelopment as opportunities for stream restoration/regional BMPs	Albemarle, Charlottesville, UVA	all	$9,600 (staff time only – over 10 years)	Albemarle, Charlottesville, UVA, developers
Total Cost Estimate:				$1,026,600

*$3,010,954 is the cost for the entire plan, which covers the Albemarle County development areas. The Moore's Creek watershed covers about 29% of the development areas, so the estimated cost of the plan was pro-rated at $3,010,954 * 0.29 = $873,000.

6.8 Maintenance Activities

Illicit discharge detection and elimination is a required minimum control measure under NPDES Phase II. As a result, Albemarle, Charlottesville and UVA all include the enactment of an illicit discharge ordinance to prohibit non-stormwater discharges into the stormwater system, the development of a plan to detect and address non-stormwater discharges, and inspection of storm sewer outfalls during dry weather in their permits. Much of this work will be carried out by the TJSWCD for Albemarle County as part of its contract with them. NPDES Phase II also requires the establishment of pollution prevention plans for municipal and public facilities. Charlottesville and Albemarle have additionally established a pollution prevention hotline.

Table 6.8. Maintenance activities

Activity	Entity	Estimated Cost	Potential Funding Source
Enact an illicit discharge ordinance prohibiting non-stormwater discharges into stormwater system	Albemarle County, Charlottesville (complete), UVA	$9,775 (Albemarle)	Albemarle, Charlottesville, UVA
Develop a plan to detect and address non-stormwater discharges	Albemarle County, Charlottesville, UVA	$11,500	Albemarle, Charlottesville, UVA
Develop, train, and coordinate volunteer network for illicit discharge detection	TJSWCD	$4,800	Albemarle
Supplement the storm drain GIS with the following information: locations of all outfalls, drainage areas to point of each outfall, land use within each drainage area, locations of all inflow sites for each outfall	TJSWCD	$5,000	Albemarle
Develop & maintain monitoring, tracking & reporting protocols for detection of illicit discharges from storm drain outfalls	TJSWCD	$6,000	Albemarle
Provide staff for outfall monitoring and training/coordination of volunteer network to supplement staff monitoring	TJSWCD	$9,000	Albemarle

Table 6.8 cont.

Activity	Entity	Estimated Cost	Potential Funding Source
Provide leadership & guidance for the existing StreamWatch Program to enhance its scope to include illicit discharge recognition	TJSWCD	$1,000	Albemarle
Inspect storm sewer outfalls	Albemarle, Charlottesville, UVA	$22,500/Albemarle (over 10 years); Cost is combined with next item for Charlottesville	Albemarle, Charlottesville, UVA
Dedicate staff to stormwater maintenance	Albemarle, Charlottesville	$80,000/Albemarle (over 10 years); $1,225,000* for stormwater crew (Charlottesville)	Albemarle, Charlottesville
Stormwater structure maintenance and repairs	UVA	$1,000,000 (over 10 years, based on 2004 expenditure)	UVA
Establish pollution prevention hotline	Charlottesville, Albemarle	$5,000 (over 10 years)	Charlottesville, Albemarle
Pollution prevention plans for municipal and public facilities	Albemarle, Charlottesville, UVA	$15,000	Albemarle, Charlottesville, UVA
Total Cost Estimate:			$2,394,575

*Charlottesville staff estimates $350,000/yr for a stormwater crew. Assuming they spend a proportional 35% of their time in the Moore's Creek watershed, this comes to $122,500/yr or $1,225,000 over 10 years.

6.9 Cost/Benefit Analysis

The total costs of the actions in Sections 6.1 – 6.8 are summarized in the following table.

Table 6.9 Total costs of implementation actions

Implementation Action Type	Cost
Animal exclusion and buffers	$325,000
Stream bank protection and stabilization	$730,905
Sanitary sewer system improvements	$14,367,525
Failing septic system and straight pipe correction	$733,000
Urban/residential education programs	$383,375
Planning activities	$1,026,600
Maintenance activities	$2,394,575
Total Cost Estimate:	$19,960,980

A cost/benefit analysis in a mixed-use watershed such as this one is of necessity very rough. For one thing, benefit estimates for many of the practices proposed are not available. Additionally, the costs available at this point are incomplete, as many depend on the completion of further plans and studies. This is particularly true for activities in urban and residential areas. The following analysis uses the costs that are available to date, and makes the assumption that the actions proposed would accomplish the required reductions. The one exception is the calculation for streambank protection and

stabilization, which assumes a 40% reduction in the contribution to the stream. Minor differences in reduction/$ ratios are probably insignificant given the unknowns, but order-of-magnitude differences do offer some guidance as to where dollars should be spent. Of course, many of the activities in this plan are ones that the localities are already planning to fund, so although they may not offer the greatest benefit per dollar they are "free" from the standpoint of requiring outside funding.

In order to make a rough cost/benefit estimate, an estimate was made of the reduction required by the TMDL of bacteria in the stream for each source category. For streambank protection and stabilization, the reduction was assumed to be 40% of the contribution from the land that the projects would cover (the contribution was prorated according to the area of land treated/total area of land use). For septic systems, calculations were made according to subwatershed and the age of the homes (as was done in the TMDL) to divide the reductions according to the actions proposed. For other categories, no attempt was made to divide the reductions, with the exception of pet waste, which will be discussed later. Although individual estimates were not made for each of the agricultural BMPs, it is reasonable to assume that projects which address more animals per dollar, particularly cattle and goats (research performed for the TMDL indicated that horses' fecal coliform production rates are two orders of magnitude smaller), will have better cost/benefit ratios.

Table 6.10 Cost/Benefit Summary

Measure	Reduces inputs from	Reduction (bacterial cfu/yr)	Cost	Reduction/$ ratio
Animal exclusion and buffers	Cattle and grasslands	$1.024 * 10^{14}$	$325,000	$3.151 * 10^{8}$
Streambank protection and stabilization	Grasslands and residential	$2.346 * 10^{12}$	$730,905	$3.210 * 10^{6}$
Maintenance and repairs for sanitary sewer	Sewer leakage	$7.239 * 10^{12}$	$8,900,000	$8.134 * 10^{5}$
Connection of Oak Hill to public sewer	~20 leaking septic systems	$3.059 * 10^{12}$	$1,210,000	$2.528 * 10^{6}$
Other public sewer connection projects	~96 leaking septic systems + 1 mass drainfield	$1.172 * 10^{13}$	$4,257,525	$2.753 * 10^{6}$
Repair/replace other septic systems/educate owners	Straight pipes and ~118 leaking septic systems	$4.244 * 10^{13}$	$733,000	$5.790 * 10^{7}$
Education, planning and maintenance activities	Residential and urban land uses	$1.148 * 10^{14}$	$3,804,550	$3.017 * 10^{7}$

From Table 6.10, it is clear that animal exclusion and buffers are likely to offer the greatest reduction in bacterial populations in Moore's Creek, and should be a very high priority. Repair or replacement of septic systems appears to be more cost-effective than public sewer connection, although in neighborhoods with small lots, public sewer connection may be the only option. Although it appears that the Oak Hill connector is

slightly less beneficial per dollar spent than the others proposed, it should be remembered that the number of leaking septic systems was estimated in the TMDL based solely on the age of the home, and many other features such as soil, topography, and correct sizing of the system may come into play. Local observations should be given more weight than this analysis in choosing which areas to connect first. Activities in urban and residential areas appear to be nearly as beneficial as repair/replacement of septic systems, although it should be kept in mind that this is the most incomplete cost. However, an additional calculation was made which pointed out the importance of pet waste education. According to information supplied by Dr. Teresa Culver, the contribution to the stream of pets (primarily dogs, which produce six orders of magnitude more fecal coliform than cats per animal, again according to research performed for the TMDL) is $1.753 * 10^{14}$ cfu/yr. This was figured in as part of the residential and urban contributions to the stream, which totaled $3.203 * 10^{14}$ cfu/yr. $1.753 * 10^{14}/3.203 * 10^{14} = 55\%$. If the estimated cost of pet education of $72,500 addressed even 10% of the pet input to the stream, this would be a reduction/$ ratio of $1.753 * 10^{14}/\$72,500 = 2.418 * 10^{8}$ – putting it in league with animal exclusion and buffers as an activity with a high benefit for the cost.

Again, it should be remembered that many of the activities proposed such as sanitary sewer maintenance/repairs and illicit discharge detection are already locally funded, and in many cases required by the TMDL or by law. However, of those activities for which outside funding will be necessary or helpful, animal exclusion and buffers, repair/replacement of septic systems and septic system owner education, and pet waste education would appear to be high priorities.

7.0 Measurable Goals and Milestones

7.1 Implementation Goals

The ultimate goal of this implementation plan is to bring Moore's Creek into compliance with water quality standards, which will result in its removal from the 303(d) list of impaired waters. This goal will be measured by the concentration of fecal coliform and E. coli in samples, but milestones along the way will include both water quality measurements and the implementation of best management practices. Implementation goals must keep in mind the TMDL allocation goals. The TMDL called for 100% reduction in direct cattle and straight pipe inputs, septic NPS, and sewer leakage. It also called for reductions in contributions from land uses equivalent to removal of the impact from 118 acres of low-density residential land, 827 acres of medium-density residential land, 771 acres of grassland, and 1070 acres of urban land. At the same time, practicality must be considered. For example, retrofitting urban land can be difficult and costly, as urban areas have few sites suitable for the construction of large-scale BMPs. The construction of BMPs in the urban area will be to some extent dependent on opportunities presented during redevelopment.

The major goal to bring Moore's Creek into compliance is broken down into sub-goals and objectives. These reflect the activities outlined in the previous section:

GOAL: Remove cattle from the stream and achieve targeted reductions in grassland inputs.

- OBJECTIVE: Educate targeted landowners in funding available and procedures for implementing BMPs on their properties.
- OBJECTIVE: Install appropriate BMPs such as fencing, buffers, alternative water systems, and stream crossings on pasturelands.
- OBJECTIVE: Bring stockyard into compliance with state standards and install appropriate BMPs.
- OBJECTIVE: Restore and protect stream banks for additional reductions, where found to be cost-effective.

GOAL: Implement stormwater best management practices to aid in reducing inputs from urban uses.

- OBJECTIVE: Seek opportunities for remediation with redevelopment.

GOAL: Reduce inputs in residential and urban areas through removal of leaking sewers and failing septic systems.

- OBJECTIVE: Upgrade lines that are known sources of overflows.
- OBJECTIVE: Prevent infiltration/exfiltration through manhole relining.
- OBJECTIVE: Seek and repair leaks in lines.
- OBJECTIVE: Connect subdivisions with large quantities of failing septic systems to public sewer.

GOAL: Reduce inputs in rural areas through removal of failing septic systems and straight pipes.

OBJECTIVE: Repair/replace failing septic systems in Southwood Mobile Home Park.
OBJECTIVE: Develop funding assistance program for septic problems.
OBJECTIVE: Develop plan for straight pipe detection.
OBJECTIVE: Educate owners of septic systems regarding proper care and maintenance.

GOAL: Reduce inputs in urban and residential areas through education.
OBJECTIVE: Provide public education on pet waste management.
OBJECTIVE: Utilize stormwater education partnership and website to help promote good stewardship in the Moore's Creek watershed.
OBJECTIVE: Use media to increase awareness of issues and good stewardship practices.
OBJECTIVE: Include education about water quality and creek stewardship in local school curricula.
OBJECTIVE: Offer educational programs and literature through homeowners' associations and other groups.
OBJECTIVE: Educate owners of stormwater BMPs about maintenance.
OBJECTIVE: Use Adopt-a-Stream and storm drain stenciling programs as venues for education about creek stewardship.

GOAL: Through planning activities, identify and prioritize opportunities for stream protection and restoration, and ensure that codes and design standards are "water-quality friendly."
OBJECTIVE: Develop and revise as necessary master plans and action lists for watershed.
OBJECTIVE: Review and adopt codes and design standards as needed.
OBJECTIVE: Use new development and redevelopment as opportunities for stream restoration and/or regional BMPs.

GOAL: Reduce urban and residential inputs by performing inspection, monitoring and maintenance activities to eliminate illicit discharges, ensure proper stormwater system performance and prevent pollution.
OBJECTIVE: Enact illicit discharge ordinances.
OBJECTIVE: Locate and inspect all stormwater outfalls.
OBJECTIVE: Detect and address non-stormwater/illicit discharges.
OBJECTIVE: Maintain and repair stormwater structures.
OBJECTIVE: Establish and maintain a pollution-prevention hotline.
OBJECTIVE: Adopt pollution prevention plans for municipal and public facilities.

7.2 Implementation Milestones

DEQ is recommending a staged implementation approach, such that those activities likely to have the greatest impact on the concentration of pollutants in the waterway are carried out first. This example for bacteria is given in the *TMDL Implementation Plan Guidance Manual*:

- Stage I: Eliminate direct inputs to the stream from humans and reduce direct inputs from livestock.
- Stage II: Further reductions in direct inputs from livestock and eliminate input from near-stream sources (such as loafing and feed lots, and manure storage areas) as well as inappropriate manure application near stream and failing septic systems in the near-stream areas.
- Stage III: Eliminate input from far upland sources (such as loafing and feed lots, and manure storage areas) as well as inappropriate manure application and failing septic systems in the upland areas.

In the development of this plan, staging for effectiveness of actions had to be balanced with other considerations such as cost and the timelines of other plans. For example, some of the sewer line extensions proposed would qualify as Stage II activities under the above example, but the cost of the extensions necessitates that the extensions be constructed later in the implementation process unless additional funding is obtained. And although elimination of straight pipes would be a Stage I activity, it may take some time and effort to locate them.

Table 7.1 Implementation timeline

2003	
Establish pollution prevention hotline	Charlottesville, Albemarle
Pollution prevention plans for municipal and public facilities	Charlottesville, UVA
2004	
Dovetail stormwater and water quality education with Standards of Learning	Charlottesville
Review and amend City code for adequate coverage of issues including erosion and sediment control, stream protection, and stormwater management	Charlottesville
Begin inspection of storm sewer outfalls	UVA
Begin developing pollution prevention plans for municipal and public facilities	Albemarle
2005	
Approach agricultural landowners regarding participation in cost-share plan	TJSWCD
Upgrade Stadium line	Charlottesville
Connect Southwood MHP	Owner
Repair failing septic systems at Southwood MHP	Owner
Dovetail stormwater and water quality education with SOLs	Albemarle
Develop menu of stormwater/watershed lesson plans and provide staff to guide teachers' use	TJSWCD
Develop mailing list of homeowners' association contacts	TJSWCD
Develop educational materials for BMP owners	Albemarle
Continue & expand Adopt-A-Stream Program and storm drain stenciling program with youth groups and citizen groups	TJSWCD

Table 7.1 cont.

2005	
Adopt design standards that improve erosion and sediment control, stream protection, and stormwater management	Charlottesville
Enact an illicit discharge ordinance prohibiting non-stormwater discharges into stormwater system	Charlottesville, Albemarle, UVA
Develop a plan to detect and address non-stormwater discharges	Charlottesville, Albemarle, UVA
Begin inspection of storm sewer outfalls	Charlottesville
2006	
Complete 1/3 of cost-share projects	TJSWCD
Complete remediation of stockyard	Owner
Begin construction of buffer projects	Albemarle, TJPDC
Develop plan for failing septic system and straight pipe detection	Albemarle, Charlottesville, TJSWCD, TJPDC, VDH
Conduct teacher workshop for incorporation of stormwater/watershed education into curriculum	TJSWCD
Coordinate/schedule use of watershed model in local middle schools (public & private)	TJSWCD
Develop brochures & fact sheets for distribution to homeowners associations, youth groups, & the development community	TJSWCD
Complete City-wide watershed-based water quality planning effort	Charlottesville
Begin inspection of storm sewer outfalls	Albemarle
Dedicate staff to stormwater maintenance	Charlottesville, Albemarle, UVA
Complete development of pollution prevention plans for municipal and public facilities	Albemarle
Develop, train, and coordinate volunteer network for illicit discharge detection	TJSWCD
Supplement the storm drain GIS	TJSWCD
Develop & maintain monitoring, tracking & reporting protocols for detection of illicit discharges from storm drain outfalls	TJSWCD
Provide staff for outfall monitoring and training/coordination of volunteer network to supplement staff monitoring	TJSWCD
Provide leadership & guidance for the existing StreamWatch Program to enhance its scope to include illicit discharge recognition	TJSWCD
2007	
Complete 2/3 of cost-share projects	TJSWCD
Increase size of Valley Rd collector line	Charlottesville

Table 7.1 cont.

2007	
Develop funding assistance program for septic problems/straight pipes	TJSWCD
Develop education program for septic owners	TJSWCD
2008	
Agricultural cost-share projects completed	TJSWCD
Complete construction of buffer projects	Albemarle, TJPDC
2009	
Straight pipes replaced	TJSWCD, Homeowners
Oak Hill sewer completed	ACSA, Homeowners
2015	
Manhole relining completed	Charlottesville
Complete smoke/dye testing of sewer lines	Charlottesville
Failing septic systems replaced in rural areas	TJSWCD, Homeowners
Unscheduled	
Stagecoach Rd./etc. extension completed with homeowner participation	ACSA, Homeowners
Buckingham Circle sewer completed with homeowner participation	ACSA, Homeowners
Bellair Liberty Hill sewer completed with homeowner participation	ACSA, Homeowners
Ednam Forest sewer completed with homeowner participation	ACSA, Homeowners
Stream bank protection projects completed	Albemarle, TJPDC
Continuing	
Public education on pet waste management	Charlottesville, Albemarle, UVA, TJPDC
Stormwater education partnership and website	Charlottesville, Albemarle, UVA, RWSA, VDOT
Utilize website to register, track, and address citizen complaints regarding stormwater issues	TJSWCD
Utilize local media to promote awareness	Charlottesville, Albemarle, UVA
Organized education on stormwater	Charlottesville, Albemarle, UVA
Continue to revise and improve stormwater master plan	UVA
Use new development/ redevelopment as opportunities for stream restoration/regional BMPs	Charlottesville, Albemarle, UVA
Dedicate staff to stormwater maintenance	Albemarle, Charlottesville
Stormwater structure maintenance and repairs	UVA

7.3 Water Quality Monitoring and Milestones

DEQ will monitor the creek bimonthly for fecal coliform and E. coli at its established monitoring location, which is the bridge crossing the creek at the Moore's Creek WWTP (upstream of the plant outfall). Additionally, RWSA is willing to take monthly fecal coliform and E. coli samples at the same site. However, RWSA staff has expressed a strong desire for a replacement of the gage at the site (the original staff gage purchased during the bacterial source tracking study has sheared off), in order to correlate flow with bacteria counts, and have requested funding assistance to do so. The cost to replace the staff gage with another one is $2,000, and the cost to replace it with a gage that could be mounted on the bridge (and therefore not subject to the same breakage) would be $3,000. The StreamWatch monitoring program is interested in expanding its mission to include the use of ColiScan® Easygel® for E. coli sampling throughout the Rivanna watershed, but would need funding assistance for supplies and volunteer training and coordination.

In calculating water quality milestones, the following assumptions were used:

- Water quality benefits would be seen the year following the completion of the activity.
- The stockyard would be remediated by 2006; effects of other agricultural projects would be approximately evenly distributed over the 2007-2009 period.
- Because modeling the effects over time of septic system replacement, sewer repair, education, maintenance, and any activities that may arise as the result of planning activities is impossible given the unknowns, a simple linear function was used, with the assumption that remediation in each case would be complete by 2015.
- Full compliance will be achieved within 10 years, with additional projects scheduled if necessary after 2010.

Table 7.2 Water quality timeline

Year	Inputs expected to be reduced	Percent achieved toward compliance
2006	Urban, residential, sewer leakage	4.3%
2007	Urban, residential, sewer leakage, stockyard, livestock/grasslands	26%
2008	Urban, residential, sewer leakage, livestock/grasslands, rural septic	41%
2009	Urban, residential, sewer leakage, livestock/grasslands, rural septic, straight pipes	59%
2010	Urban, residential, sewer leakage, rural septic, straight pipes, Oak Hill	68%
2015	Urban, residential, sewer leakage, rural septic, other projects as needed	100%

7.4 Implementation Tracking and Evaluation of Progress

It is to be expected that participating agencies such as TJSWCD, Albemarle County and the City of Charlottesville will keep track of their own efforts. However, to ensure that overall implementation and water quality milestones are being met, one agency should

take responsibility for keeping track of both and reconvening the technical committee periodically to discuss progress and address any new developments. The TJPDC, as the agency that has historically coordinated TMDL and IP efforts, is a logical choice. No other agency involved has the staff capacity to take on coordination of the implementation effort. However, outside funding would be needed in order to devote the amount of staff time needed.

A major revisitation of the plan should occur in 2010. This will be the halfway point for the implementation timeline and should be the point at which about 2/3 of the water quality goals have been achieved. Based on the actual progress made to that point and any new information, implementation projects, goals and milestones may be added or revised.

8.0 Stakeholders' Roles and Responsibilities

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this TMDL effort (i.e., improving water quality and removing Moore's Creek from the impaired waters list). The purpose of this chapter is to identify and define the roles of the stakeholders who will work together to implement the plan. The roles and responsibilities of some of the major stakeholders are described below.

8.1 Federal Government

U.S. Environmental Protection Agency (EPA): EPA has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states.

Natural Resources Conservation Service (NRCS): NRCS administers several funding programs for water quality and stream protection, including the Wildlife Habitat Incentive Program, the Wetland Reserve Program, the Conservation Reserve Program, and the Environmental Quality Incentives Program.

8.2 State Government

In the Commonwealth of Virginia, water quality problems are addressed through legislation, incentive programs, education, and legal actions. Currently, there are a number of state agencies responsible for regulating and/or overseeing statewide activities that impact water quality in Virginia. These agencies include: DEQ, DCR, the Virginia Department of Agriculture and Consumer Services (VDACS), VDH, the Virginia Department of Forestry, and the Virginia Cooperative Extension.

DEQ: The State Water Control Law authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses. For many years the focus of DEQ's pollution reduction efforts was the treated effluent discharged into Virginia's waters via the VPDES permit process. The TMDL process has expanded the focus of DEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the pollutants causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs.

DEQ is the lead agency in the TMDL process. The Code of Virginia directs DEQ to develop a list of impaired waters, develop TMDLs for these waters, and develop IPs for the TMDLs. DEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs to EPA and the State Water Control Board for approval. DEQ is also responsible for implementing point source WLAs, assessing water quality across the state, and conducting water quality standard related actions.

DCR: DCR is authorized to administer Virginia's NPS pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the Clean Water Act. EPA is requiring that much of the §319 grant monies be used for the development of TMDLs.

Because of the magnitude of the NPS component in the TMDL process, DCR is a major participant in the TMDL process. DCR has a lead role in the development of IPs to address correction of NPSs contributing to water quality impairments. DCR also provides available funding and technical support for the implementation of NPS components of IPs. The staff resources in DCR's TMDL program focus primarily on providing technical assistance and funding to stakeholders to develop and carry out IPs, and support to DEQ in TMDL development related to NPS impacts. DCR staff will also be working with other state agencies, Soil and Water Conservation Districts, and watershed groups to gather support and to improve the implementation of TMDL plans through utilization of existing authorities and resources.

VDACS: THE VDACS Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken, which may include civil penalties. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures.

VDH: The VDH is responsible for maintaining safe drinking water measured by standards set by the EPA. Their duties also include septic system regulation and regulation of biosolids land application. Like VDACS, VDH is complaint driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. For TMDLs, VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq*.).

DOF: The DOF has prepared a manual to inform and educate forest landowners and the professional community on proper BMPs and technical specifications for installation of these practices in forested areas (http://www.dof.virginia.gov/wq/index-bmp-guide.shtml). Forestry BMPs are directed primarily to control erosion. For example, streamside forest buffers provide nutrient uptake, soil stabilization, and filtration, which can benefit water quality by reducing the amount of nutrients, sediments, and even bacteria that enter local streams.

VCE: VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education, and Extension Service, an agency of the United States

Department of Agriculture. VCE is a product of cooperation among local, state, and federal governments in partnership with citizens. VCE offers educational programs and technical resources for topics such as crops, grains, livestock, poultry, dairy, natural resources, and environmental management. VCE has issued several publications that deal specifically with TMDLs. For more information, visit http://www.ext.vt.edu.

Thomas Jefferson Soil and Water Conservation District: The TJSWCD serves the counties of Albemarle, Fluvanna, Louisa, and Nelson. SWCDs are self-governed subdivisions of state government, funded through local and state appropriations and a variety of grants. The TJSWCD promotes soil and water conservation through providing technical expertise and education. Activities of the District include technical and financial assistance for the installation of conservation practices, development and oversight of conservation plans for agricultural lands, conservation education, administration of grant funds targeted to protect the habitat of the James River Spinymussel, and a conservation easement program. The District will be instrumental in implementing agricultural BMPs and woodland buffers. In conjunction with ongoing education program the District will be implementing portions of Albemarle County's NPDES/VPDES Phase II Stormwater program. Three major areas the District will be working in include outreach/education, public involvement, and illicit discharge detection.

8.3 Local Government

Thomas Jefferson Planning District Commission: The TJPDC serves Albemarle, Fluvanna, Greene, Louisa and Nelson Counties, and the City of Charlottesville. Planning District Commissions were established in 1969 by Virginia's General Assembly to encourage and facilitate regional solutions to problems of area-wide significance. PDCs are made up of elected officials and citizens appointed by local governments, and receive their funding from a mix of local, state and federal sources. As water quality is frequently a regional issue, many PDCs have naturally become involved in related planning, including TMDLs and IPs. The TJPDC has been working in the Moore's Creek watershed since 1999, beginning with a bacterial source tracking study, through the development and adoption of the TMDL in 2002, and finally with the development of the IP. The TJPDC will work to obtain funding for and/or manage implementation projects that do not have commitments from other organizations. The TJPDC will also reconvene the technical committee at least once a year to gauge progress toward implementation. More detailed oversight of implementation plan progress would be dependent on the receipt of outside funding.

Rivanna Water & Sewer Authority: RWSA is an independent public agency providing impoundment, treatment, storage and transmission of potable water and transport and treatment of wastewater for the citizens of Charlottesville and Albemarle County. RWSA operates the wastewater treatment plant located near the mouth of Moore's Creek and owns some of the collector lines in the watershed. They also participate in the regional stormwater education partnership. RWSA's fecal coliform data for Moore's Creek contributed greatly to the development of the TMDL. RWSA anticipates resumption of

fecal bacteria measurements in the creek albeit on a less-frequent basis, which will be of great service in tracking progress in water quality.

Albemarle County: Albemarle County comprises the southern and western portions of the watershed, which contain the majority of the low-density residential and agricultural areas, as well as some areas of greater density. Development of the TMDL and IP involved both the staff of the Water Resources Team in the Department of Community Development and staff from the Albemarle County Service Authority.

The Water Resources Team manages programs for stormwater master planning, groundwater, and water supply and watershed planning (in conjunction with the Rivanna Water & Sewer Authority). They are also part of the regional stormwater education partnership. The Water Resources Team will be involved in the implementation of many of the activities related to the NPDES Phase II permit, such as stormwater education and master planning and the drafting of an illicit discharge ordinance.

Albemarle County Service Authority: ACSA is a Water and Sewer Authority chartered to provide utility service in Albemarle County. It is governed by a Board of Directors appointed by the Albemarle County Board of Supervisors. ACSA provides public water and sewer service to the residents and businesses of the County in the urban area. The Authority's sole source of revenue is from the sale of water and wastewater treatment. ACSA will be involved in the expansion of service to areas with high percentages of failing septic systems should resources become available to assist in the cost of the projects.

City of Charlottesville: Charlottesville comprises much of the northern and most urban portion of the watershed. The Department of Public Works (DPW) has primary responsibility for the City's MS4 permit and is responsible for maintenance and operation of both the City's storm sewer system and the City's sanitary sewer system. The Department of Neighborhood Development Services (NDS) shares authority for the storm sewer discharge program, and is the primary program authority for the new Water Protection Ordinance that includes a stormwater program and the new stream buffer requirements. As part of their Phase II activities, Charlottesville is also involved in the regional stormwater education partnership.

University of Virginia: UVA, although technically located in Albemarle County, acts as a separate government entity in many ways, including applying for its own NPDES Phase II permit and participating separately in the stormwater education partnership. The Office of the Architect is responsible for master planning, including stormwater master planning, while UVA's Environmental Compliance Manager is responsible for environmental impact reviews and stormwater education.

8.4 For-Profit and Nonprofit Organizations and Citizens

Belmont Neighborhood Association: Both the TMDL and the IP process included some participation from members of the Belmont Neighborhood Association, one of the most active neighborhood associations in the watershed. Neighborhood associations can be

key partners in education; the Belmont Neighborhood Association did a story about the Moore's Creek TMDL in their newsletter.

Farm Bureau: Representatives of the Albemarle County and Virginia Farm Bureaus were involved in the development of the TMDL and implementation plan. Their participation was critical in determining the extent and location of the livestock population in the watershed, and their connection to the agricultural community was and will continue to be extremely helpful.

The Nature Conservancy: TNC has identified the Rivanna River, of which Moore's Creek is a tributary, as one of the best remaining examples of a Piedmont stream. TNC has prepared a strategy for the Rivanna and is administering funding for its restoration, some of which may be useable for projects in the Moore's Creek watershed.

Rivanna Trails Foundation: Some of the trails of the Rivanna Trails Foundation run along the mainstem and tributaries of Moore's Creek. Although not directly participating in plan development, RTF volunteers were helpful in providing information about physical conditions. RTF regularly sponsors trail work and cleanup, which benefits Moore's Creek through trash removal and increased public exposure and "ownership."

Southern Environmental Law Center: Staff from SELC participated in the development of the TMDL and IP. SELC has been involved in the development and defense of TMDL rules since the mid-1990s.

Citizens: Ultimately, much of the implementation will be up to the citizens of the Moore's Creek watershed, whether in choosing to install vegetated buffers on their properties or using pooper-scoopers while walking their dogs. Government or community groups may assist with education, technical, or financial assistance, but it will be the goodwill of those living and working in the watershed that makes the difference.

9.0 Integration with Other Watershed Plans

This implementation plan has drawn directly from some existing plans and programs, and has been impacted by or may impact others. Plans and programs that relate to it include:

NPDES Phase II Stormwater Permits: Albemarle County, the City of Charlottesville and the University of Virginia all have stormwater permits under NPDES Phase II. The NPDES Phase II rule requires operators of small municipal separate storm sewer systems to develop a stormwater management program. Aspects of the program must include public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention/"good housekeeping." Many of these aspects, including public education and illicit discharge detection and elimination, relate directly to the Moore's Creek Implementation Plan and were included as implementation measures.

ACSA Capital Improvement Plan: The Albemarle County Service Authority has identified a number of urban communities that rely on drainfields to dispose of sewerage. In anticipation of the need to extend public sewer into these communities, the subdivisions are listed in their CIP. This work will improve water quality in Moore's Creek by replacing failing septic systems with sewer lines, and were therefore included in the Moore's Creek IP.

Albemarle County Stream Assessment Program/Stormwater Management Master Plan: The Stream Assessment Program, completed in 2003, laid the groundwork for the ultimate development of a stormwater master plan for the County. County staff walked approximately 100 miles of stream corridor in order to document habitat conditions, impacts on the stream from specific infrastructure and problem areas, typical stream cross sections, and general stream characteristics. Community values related to the stream corridor were also considered. Streams were designated as pocket natural areas, community and private use/trails, designed urban water features, and urban/engineered. Moore's Creek, its Biscuit Run and Ragged Mountain Creek tributaries, and the lower reaches of Morey Creek were considered to be primarily community and private use/trails with some pocket natural areas, but the upper reaches of Morey Creek, the entirety of Cow Branch, and the smaller tributaries were considered to be urban water features, which were given a lower priority for protection. The stream assessment data were used to identify high priority restoration projects. A prioritized list of buffer and erosion projects was identified based on severity, feasibility, and consistency with master plans and community goals; the highest-ranking ones for the Moore's Creek watershed have been included in the IP. Regional stormwater facility locations were also identified as part of the Stormwater Management Master Plan, but none were in the Moore's Creek watershed.

Rock Creek Stream Valley Master Plan: This study was jointly funded by Charlottesville and UVA in 1997 and performed by The Cox Company. It assessed the condition of, surveyed and made recommendations for stream rehabilitation and storm drainage improvements to Rock Creek, one of the primary tributaries to Moore's Creek in the City

of Charlottesville. Unfortunately, at over $1 million the construction cost estimate for the complete project was beyond the resources of the City or University. Implementation of some of the recommendations of the plan may still be worth considering.

Moore's Creek Watershed Study: This study was completed in 1996 by Dewberry & Davis for Albemarle County and the City of Charlottesville. It included hydrologic and hydraulic analyses, water quality data and analysis, an evaluation of various stormwater mitigation measures, and a watershed plan. The construction of regional stormwater management facilities was considered, but the only possible sites were located in the undeveloped parts of the watershed, which would offer limited benefits. Many of the immediate action items in the study have been completed, including the development of a stormwater management ordinance, a design and construction standards manual, and a watershed geographic information system (GIS), and stabilization of the banks of Moore's Creek at Azalea Park. A number of the other action items, such as culvert and bridge replacement and debris removal, were more related to flood control than to water quality improvement. The immediate construction of 100' of channel stabilization for Monticello Avenue Creek was also recommended. The secondary stormwater management plan included many thousands of dollars of stream restoration projects, including $792,000 along Moore's Creek, $65,000 along Monticello Avenue Creek, $250,000 along Rock Creek, $250,000 along a tributary to Rock Creek, $125,000 along Pollock's Branch, and $650,000 along Biscuit Run. These estimates were not based on detailed assessments but on a simple calculation of 30 projects per mile x X miles x an average of about $10,500 per project. At this point, the recommendations of this study for restoration in the County part of the watershed would be superseded by the more comprehensive and more recent Albemarle County Stream Assessment Program/Stormwater Management Master Plan.

Southern Urban Area B Study: This 2004 study, jointly sponsored by Charlottesville, Albemarle and UVA, examined alternative transportation corridors and development patterns in a portion of the Moore's Creek watershed that includes UVA's Fontaine Research Park, Jefferson Park Avenue and Sunset Avenue in the City, and Sunset Avenue Extended in the County. Several of the transportation corridor alternatives examined would involve construction of a new bridge over Moore's Creek, and a major potential development area identified is that of the "Granger property," which lies to the south of the research park. In the land cover analysis performed for the TMDL, this property was identified as pasture and forestland, although the more recent Farm Bureau survey of livestock in the watershed did not find any located there. This property is the location of two of Albemarle County's proposed buffer control and erosion projects along Morey Creek. The Southern Urban Area B report foresees the possibility of significant housing development on the property (as many as 500-750 units) and/or the development of small-scale service and mixed use. As Morey Creek is an important tributary to Moore's Creek, development should be carefully planned in order to avoid further degradation of the creek.

Albemarle Comprehensive Plan: The Albemarle Comprehensive Plan covers water resources extensively in its Natural Resources chapter. Objectives include:

- Implement an ongoing educational and incentive program for the general public that emphasizes protection of surface and groundwaters and the property owner's responsibility and opportunity.
- Protect the County's surface water through a management program that recognizes the functional interrelationship of stormwater hydrology, stream buffers, flood plains, wetlands, and human management practices.
- Maintain the integrity of existing stream channels and networks for their biological functions and drainage. Protect the condition of state waters for all reasonable public uses and ecological functions. Restore degraded stream and wetland ecosystems where possible.
- Facilitate the integration of stormwater management and pollution control with other programs, policies, educational efforts, and Comprehensive Plans of jurisdictions in the region.
- Encourage BMPs to reduce nonpoint source pollution from agricultural and forestry uses.

Albemarle Water Protection Ordinance: Albemarle County adopted a Water Protection Ordinance in 1998, which consolidated and updated the Erosion and Sediment Control, Runoff Control, and Water Resources Protection Areas Ordinances, as well as the stormwater detention requirements of the Subdivision Ordinance. Stormwater management/BMP plans, which may include structural and/or nonstructural measures, are required for new development, and stream buffers along perennial streams and/or wetlands contiguous to those streams. Buffer widths vary from 25' for croplands to 100' in development areas to 200' within water supply protection areas. Within the Moore's Creek watershed, the land that drains to the Ragged Mountain Reservoir is a water supply protection area.

Charlottesville Comprehensive Plan: In its Guiding Principles Charlottesville's 2001 Comprehensive Plan states, "The Charlottesville community puts a value on trees, parks, green space, and biodiversity as adding to the livability and appearance of the city" and "balances the natural and built environments and practices sustainability in decisions." In its Vision Principles the Comprehensive Plan includes:

- We will promote and support the ideal of our City as a Park by expanding green space, the urban canopy, and improving access to our waterways.
- We will protect and enhance the quality of our air and water.
- We will endeavor to balance people's desire for convenience with viable alternatives that support or enhance our natural and built environment.

Charlottesville Water Protection Ordinance: The short-term work program outlined in the 2001 Comprehensive Plan included the amendment of the Code to protect the City's water quality, using the Albemarle Water Protection Ordinance as a model. A Stream Protection Task Force was formed and met during the development of the Moore's Creek IP; two members of the task force attended IP meetings as well. Toward the end of the IP development period, Charlottesville passed a water protection ordinance that requires 100' buffers for most new development along three major streams, including Moore's Creek. The ordinance also covers erosion and sediment control for land-disturbing

activities, stormwater management plans for new development, and establishes authority to address illicit discharges.

James River Tributary Strategy: Moore's Creek is a tributary of the Rivanna River, which in turn is a tributary of the James River. The draft James River Tributary Strategy is not sufficiently specific to inform the Moore's Creek IP, but many of the types of BMPs proposed in the IP are also proposed in the Tributary Strategy, as they will contribute to the reduction of nutrients and sediment as well as bacteria. Implementation of these practices will therefore contribute to the implementation of the James River Tributary Strategy as well as of the IP.

10.0 Potential Funding Sources

A number of the activities outlined in this implementation plan, particularly those relating to NPDES permits, will be carried out as part of the regular budgets of Albemarle, Charlottesville, and UVA. Others, such as the sewer line extensions outlined in the ACSA Capital Improvement Plan, may eventually be accomplished through the regular budget process but could be accomplished more quickly if outside funding were obtained. And some, such as the development of an assistance program for owners of failing septic systems, are unlikely to occur without outside funding. Possible funding sources are listed below.

Chesapeake Bay Small Watershed Grants Program: This is a partnership between the EPA Chesapeake Bay Program and the National Fish and Wildlife Foundation that provides grants to organizations working on a local level to protect and improve watersheds in the Chesapeake Bay basin. Currently the Rivanna Conservation Society and The Nature Conservancy are the recipients of a grant for James River Spinymussel habitat protection, for which Moore's Creek is a middle-priority stream. The RCS/TNC grant offers subgrants with a 25% match, which can be contributed labor.

Community Development Block Grant: Virginia Community Development Block Grants are administered by the Virginia Department of Housing and Community Development. Grants are awarded to non-entitlement communities (which include Albemarle County) for projects that address critical community development needs including housing, infrastructure, and economic development, and targeting low- to moderate-income persons. Up to $1,000,000 of VCDBG funding is available for water and wastewater improvement projects. Matching funds are not required but are a proposal evaluation consideration.

Conservation Reserve Enhancement Program: CREP is a federal cost-share program administered by NRCS, designed to improve water quality and enhance wildlife habitat. To be eligible, land must be currently grazed or cropped two of the last five years. Practices covered include fencing, alternative watering systems, and forested riparian buffer establishment. The minimum buffer width is 35' from the top of the stream bank or 1/3 of the floodplain. The contract length for this program is 10 or 15 years. There is a 50% cost-share from federal sources, and a 25% cost-share from state sources that is capped at $200/acre. Incentive and buffered area rental payments are also a part of the program. Participants in this program are also eligible for the Virginia Agricultural BMP tax credit.

EPA Section 319 Funds: EPA develops guidelines that describe the process and criteria to be used to award Clean Water Act Section 319 NPS grants to states. Up to 20% of the funds may be used by states to develop NPS TMDLs as well as to develop watershed-based plans for Section 303(d) listed waters. The balance of funding can be used for implementing watershed-based plans for waters that have completed TMDLs. Implementation of both agricultural and residential BMPs is eligible. In Virginia, this

funding is administered by DCR, which works directly with agencies interested in implementation in areas where an implementation plan has been approved.

Environmental Quality Incentives Program (EQIP): This is a federal cost-share program administered by NRCS. Practices must be part of an approved grazing management system. A 50-90% cost-share is available for fencing out water (ponds, streams, and springs) and woods and for construction of an alternative watering system. Cost share is also available for weed and fertility management and other conservation practices. For 2002-2007, there is a total cost-share cap per landowner of $450,000. The contract length for this program is 1-10 years.

Southeast Rural Community Assistance Program (SERCAP): Southeast RCAP, Inc. is a non-profit organization that has as its mission bringing clean water and wastewater facilities to rural low-income households. Its activities include providing grants for construction of new wastewater facilities for individual, isolated households, and financial assistance for hook-up costs.

Virginia Agricultural Best Management Practices Cost-Share Program: The program is administered by DCR through the local SWCDs to improve water quality in the state's streams, rivers, and the Chesapeake Bay. Agricultural conservation programs appropriate for the projects identified in the Moore's Creek watershed include:

- Grazing Land Protection (SL-6)
- Alternative Water System (SL-6B)
- Small Acreage Grazing System (SL-6A)
- Stream Protection (WP-2)
- Woodland Buffer Filter Area (FR-3)
- Streambank Stabilization (WP-2A)
- Animal Waste Control Facilities (WP-4)

All of the programs offer a 25% state tax credit on the landowner's out-of-pocket expenses; the grazing land protection, stream protection, streambank stabilization and animal waste control facility programs offer 75% cost share for appropriate implementation practices, and the woodland buffer filter area program offers a one-time incentive payment of $200/acre. Most of the programs have an annual cap per landowner. All require maintenance of the BMP for a specified period of five or 10 years, depending on the program. Minimum buffer width is 35' from the top of the stream bank for those programs involving a buffer.

Virginia Agricultural Best Management Practices Tax Credit Program: This program supports voluntary installation of BMPs that will address Virginia's nonpoint source pollution water quality objectives. Agricultural producers with an approved conservation plan can take a credit against state income tax of 25 percent of the first $70,000 spent on agricultural BMPs.

Virginia Aquatic Resources Trust Fund: This is a mitigation fund to offset stream impacts during building, administered by The Nature Conservancy, the U.S. Army Corps of Engineers, and TJSWCD. Although lands around populations of James River

Spinymussels are considered highest priority, projects in other areas that involve stream restoration and preservation of stream banks and riparian buffers are eligible as well. This program includes easement purchase and provides 100% funding for fencing, alternative water systems, streambank restoration, and the planting of a hardwood buffer, but does require a minimum 100' buffer.

Virginia Department of Transportation: VDOT performs mitigation projects to offset stream impacts in the course of their projects. When possible, the mitigation projects are performed near the impacted areas, but other sites may be used as well. VDOT pays 100% of the cost and performs the labor.

Virginia Water Facilities Revolving Loan Fund: This program provides financial assistance in the form of low-interest loans to local governments for needed system improvements at publicly owned wastewater collection and treatment facilities.

Wildlife Habitat Improvement Program: This federal cost-share program is administered by NRCS in collaboration with Ducks Unlimited, the Audubon Society, the US Fish & Wildlife Service, DOF and the Virginia Department of Game and Inland Fisheries. It offers 75% cost-share for wildlife habitat improvement activities such as fencing out riparian areas and woods, habitat enhancement, establishment of soft-edge field borders, and management of enhanced areas. All land is eligible, but there is a 2-acre minimum. The contract period is 5-10 years.